party visited Emperor and Penguin Islands and surveyed Cape Crozier with complete success. The temperatures encountered by the parties were constantly below 50 degrees and frequently below 60 degrees. The lowest recorded was 68 degrees. A third party found a new route to the west and established a depôt 2000 feet up the glacier, sixty miles from the ship.

On October 6 a party started for the strait in latitude 80 degrees south. The strait was found to contain a large glacier formed from the inland ice. Detailed information was obtained as to the exact point of junction between the barrier ice and the land, and a depôt established last year was found to have moved a quarter of a mile to the north. The party returned on December 13.

A party started on November 10, with five weeks' provisions, and reached a point 160 geographical miles south-east of the ship, travelling continuously over a level plain. No trace of land and no obstacles in the ice were encountered, and evidence was obtained showing this vast plain to be afloat. A most uniform series of magnetic observations was secured.

A party set out to the west on October 12, and reached a height of 5000 feet on the glacier, 80 miles from the ship, on October 18. The ship was reached again on October 21, and on October 26 another start was made. The party gained the summit on November 11, and crossed 180 degrees, the magnetic meridian, on November 20 in about longitude 155½ degrees east.

Commander Scott proceeded west with two men for eight and a half days, and reached a point 270 miles from the ship in latitude 78 degrees south and longitude 146½ degrees east. He regained the glacier on December 14, and reached the ship on Christmas Eve.

The interior of Victoria Land stretches continuously at a height of 9000 feet. It is evidently a vast continental plateau. No land was visible after losing sight of the ranges which front the coast. The temperatures were low and the wind increasingly strong. The glacier valley affords magnificent scenery and gives a natural geological section of the mountains. Mr. Ferrar and two men accompanied Commander Scott to the summit, and on the return journey they explored the valley in detail and discovered sandstone with plant remains.

In the middle of December a camp was formed eight miles north of the ship, and all hands were set to work on ice-saws in the neighbourhood to cut a passage out. Commander Scott arrived at the camp on December 30, and found that 180 yards of channel had been sawn in twelve days, through ice 7 feet to 8 feet thick. The open water was then 17 miles from the ship. As the canal cut had frozen over again in places, showing that the efforts were obviously futile, the men were sent back to the ship.

The relief ships arrived simultaneously at the edge of the ice on January 5. As they had closed but little on the *Discovery* by January 15, all hands were employed in sledging and collecting the instruments. The ice began to weaken between the ships on January 20, and broke rapidly towards the end of the month. The opening came within 8 miles of the ship in the early days of February. Its advance was slow, but it was increased by systematic blasting with dynamite. The crews of the relief ships were employed in making holes in the ice for this purpose. On February 12 a general break-up of the ice began, and the relief ships reached Hut Point amid much excitement. On the night of February 14 two heavy charges were exploded, and these placed the *Discovery* in open water.

On the morning of February 16 a heavy gale began. In the night the *Terra Nova* succeeded in finding shelter to the south, but in the morning was driven north. The *Discovery* dragged her anchor and was forced ashore, remaining eight hours in a critical position. The ship eventually freed herself. On February 19, 75 tons of coal were obtained from the relief ships before a fresh gale drove the *Discovery* north. The ship was kept close in along the coast line, and in the morning parted company from the other ships at Cape Washington, with a clear sea to the north.

The *Discovery* skirted the pack to the east and north, losing sight of the *Terra Nova* during a gale on February 28. It proceeded west along parallel 69½ degrees of latitude, and on March 2 the Balleny and Russell Islands were found to be identical. It continued west to the 156th meridian of longitude. The coast-line reported in this direction was found to be a mistake. No such land exists.

Auckland Island was reached on March 15. The *Terra Nova* and *Morning* rejoined the *Discovery* on March 19 and 20, after experiencing terrific weather and being compelled several times to heave to. The results of the expedition are eminently satisfactory.

UNIVERSITY EDUCATION IN SOUTH AFRICA.

THERE was an especial appropriateness about the visit of Prof. Hele-Shaw, F.R.S., to the Cape of Good Hope University on the occasion of the degree day, on February 27, when he gave an address on the true function of a university and the directions in which university work in South Africa should be strengthened and developed. Prof. Hele-Shaw, it will be remembered, is in South Africa to organise technical education in the new colonies, and he is for the present acting as senior professor in charge of the department of mechanical and electrical engineering at the Transvaal Technical Institute. This institute will, it is hoped by the local authorities of the Transvaal, develop into a university, but the university authorities at the Cape of Good Hope naturally desire that the future shall see no undesirable competition and no overlapping between the university work of Cape Town and that of the Transvaal when the latter becomes fully organised. There is in other quarters the fear that in the work of instituting new universities an undue prominence may be given to the subjects of study of a more technical kind, and that the branches of knowledge usually associated with the inculcation of cultured ideas may be neglected. All these questions were discussed at length by Prof. Hele-Shaw.

The University of the Cape of Good Hope was incorporated by an Act of the Legislature in 1873, and thereupon took the place of the Board of Public Examiners which had been similarly established in 1858 under the administration of the late Sir George Grey. In 1879 the late Queen Victoria granted a Royal Charter to the university declaring that the degrees conferred by the university are entitled to the same rank, precedence, and consideration as the degrees of any university in the United Kingdom. But, as was pointed out by the *Cape Times* of February 29, reporting the proceedings on degree day, as it is at present constituted the Cape University is almost exclusively an examining body. It is not, in the commonly accepted sense of the term, a teaching university, and however valuable it is for South Africa to number among its educational institutions a body which has the power to confer degrees, and thereby to set the seal of its authority upon the intellectual attainments of its graduates, this is not the highest of all advantages which a university can offer. This was the ideal at which the University of London formerly aimed, but which it has been able to replace by a great teaching university which it is hoped will be soon worthy of the capital of the Empire. The need for a teaching university at Cape Town is beginning to be felt in South Africa—for a university at which the students will be brought into direct touch with the professors and lecturers, and not, as at present, an institution in which knowledge is tested wholly by examination papers. It is the influence and the teaching of the university as a whole which largely contribute to stimulate that affection for their college that is so distinguishing a feature of the great English and Scottish universities.

Prof. Hele-Shaw directed the attention of the authorities of the Cape of Good Hope University to the aspirations of those who are founding the Transvaal Technical Institute, and pointed out that their ultimate ideal is the foundation of a university for the Transvaal. Under existing conditions in South Africa, says the *Cape Times*, it may well be doubted if two university establishments could be effectively maintained without injury to the interests of one or the other. But if the country makes that progress in wealth and population and prosperity which it is hoped to see realised, the day when there will be ample room for a Transvaal university may not be very far removed. There need be no friction between those at work at Cape Town and Johannesburg respectively.

It is true that with the establishment of a mining course in Johannesburg the engineering establishment at the South African College is faced to a certain extent by competition, but there is no reason why the earlier stages of instruction should not be taken at the South African College and the final stages at Johannesburg, where special facilities will exist. As to the future contingency of overlapping, Prof. Hele-Shaw suggests, in the probable event of an engineering faculty being established, that while the Transvaal could devote itself solely to mining engineering, the Cape University could develop the study of naval, architectural and marine engineering, for which there would be special facilities in the peninsula.

In his remarks on the future relations of the University of the Cape of Good Hope and the Transvaal Institute, Prof. Hele-Shaw said the present year will see the work of a professorship of engineering commence at both places, and continued, "There need be no fear of overlapping, since such a course, though suitable, and, indeed, necessary, for any branch of the constructive professions, can in the later stages be specialised to suit the local requirements. Thus in the north mining would naturally be a strong feature of a special course, whilst your city (Cape Town) has possibilities in the way of naval architecture and marine engineering which even the wildest dreams of the projector of the ship canal to Johannesburg would never contemplate for the latter city. Such a faculty of engineering, if true to its proper aims, would, by right, take its place, as representing a learned profession amongst the other great faculties, and would doubtless have its distinctive university degrees."

Speaking more particularly of the new institution at Johannesburg, Prof. Hele-Shaw said:—"The university idea will, I trust, even at its initial stages, be fully maintained in the Transvaal Institute, not by any mere artificial standards of entrance, but by the due appreciation of the spirit in which learning should be sought and teaching given. There will be due provision made that all entering students shall by their previous training be able to take full advantage of the lectures and classes, just as provision is made for this at the South African College. But the doors of the institute will be closed to no one, however humble, who seeks such knowledge and is able to take advantage of it. This freedom for the acquisition of learning is a very different thing from the granting of diplomas to those who are unworthy. In its diplomas and certificates the institute will try to follow the highest standards, and in this we can hope for your friendly cooperation and support. For the present our mining students will derive incalculable benefit from the seal and stamp which you will set upon their university career, a seal which will derive its value from the high standard which you have ever striven to maintain amongst your graduates. You may be sure that whatever developments there may be in the future when our own university becomes an accomplished fact, the same safeguards for a university degree will be enforced for our university as there are for yours. No university degree can have any value which does not insist upon evidence of some amount of literary knowledge and include an acquaintance with more than one language on the part of its graduates—in a word, upon evidence of liberal education."

Referring to the fears expressed in some quarters in connection with a possible over-multiplication of universities, Prof. Hele-Shaw remarked:—"There is abundant evidence that the proportion of the population who are imbued with a love for higher learning and a determination to secure a university standard is far greater here than in the cities of the older countries. There may, possibly, exist some fear of what I have called a multiplication of universities—a fear that one university may arise and grow at the expense of another. I have heard this fear expressed in the instances with which I myself am personally acquainted; but I have also seen this fear prove groundless. In the first place, it is known that the university which lowers its standard in the hope of attracting students thereby inevitably compasses its own downfall, and in the second place the remarkable effect of the institution of a new university seems to be that, whilst educational enthusiasm has been aroused in a new centre, a patriotic and zealous spirit has been rekindled in the old, and both universities have flourished where before one was only languishing."

THEORY OF AMPHOTERIC ELECTROLYTES.[1]

AMPHOTERIC electrolytes are those which are capable of acting as acids towards bases and as bases towards acids. One of the simplest types is that of the amino-acids, for example, glycine, $NH_2.CH_2.COOH$, which in virtue of the NH_2 group is an anhydrous base, whilst in virtue of the COOH group it is an ordinary organic acid. When such a substance is dissolved in water, it is ionised as acid, as base, and as the salt formed by their reciprocal neutralisation. From molecular weight determinations in aqueous solution it is found that in general the molecule is simple and not double, so that the unionised salt must be

$$\overline{NH_2.CH_2.COO}$$

The theory of the ionisation and electrical conductivity of the aqueous solutions of amphoteric substances may be deduced by a consistent application of the law of mass action and Arrhenius's theory of electrolytic dissociation. If the anhydrous electrolyte is represented by the formula X, and the hydrated form by the formula HXOH, the ions found in the solution will be

H+	OH−	XOH−	HX+
a	b	c	d

The letters beneath the formulæ represent the active masses for equilibrium of the corresponding ions. With regard to the active masses of the various forms of unionised electrolyte, it can easily be shown that these are in fixed ratios, whatever the concentration may be. We may therefore represent the sum of the active masses of the unionised forms by the letter u, and by considering the equilibrium of the different pairs of positive and negative ions, arrive at the following expressions:—

$$a=\sqrt{\frac{K+k_a u}{1+\frac{k_b}{K}u}}$$

$$b=K/a$$

$$c=k_a u a$$

$$d=k_b u a/K,$$

in which K represents the ionic product for water, k_a the dissociation constant of the amphoteric electrolyte acting as acid, and k_b the dissociation constant of the amphoteric electrolyte acting as base. The value of K is well known, and k_a and k_b may be obtained from measurements of the degree of hydrolytic dissociation of salts of the amphoteric electrolyte. For feebly ionised electrolytes u is very nearly equal to the total active mass, and may be assumed to be so in the first approximation. It is therefore possible to calculate the concentrations of the various ions from a knowledge of the constants given above and of the total concentration. From these ionic concentrations and the corresponding ionic velocities the electrical conductivity of the solution may then be calculated.

This calculation has been made from Winkelblech's data for the amino-benzoic acids, and satisfactory agreement obtained with the observed numbers. For such substances the dissociation constants calculated from the conductivity by Ostwald's formula have been always found to be abnormal. The theory given above explains the abnormality, and accounts numerically for the variation in the "constant."

In general it may be said that in the case of amphoteric acids which have a ratio k_b/K of the order 100 to 1000, the Ostwald constant k_0 is greater than the true acid constant k_a at high concentrations, falls to a minimum considerably lower than k_a, finally to rise asymptotically to the true value k_a as dilution progresses. The conductivity at the high concentrations is chiefly due to the ionisation of the electrolyte as salt, whereas at the high dilutions it is mostly due to the ionisation of the electrolyte as acid. In consequence of this, the measurement of the conductivity of solutions of amphoteric electrolytes affords no criterion of their strength as acids. An amphoteric electrolyte in which the acidic and basic constants are equal would give solutions absolutely neutral at all concentrations, and possessing a molecular conductivity invariable with the dilution, thus differing from all simple acids, bases or salts.

[1] Substance of a paper by Prof. James Walker, F.R.S. Read before the Royal Society on February 18.